

ACCESSION #: 9606190227
LICENSEE EVENT REPORT (LER)

FACILITY NAME: WATERFORD STEAM ELECTRIC STATION UNIT 3 PAGE: 1
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DOCKET NUMBER: 05000382

TITLE: REACTOR TRIP DUE TO FAILURE OF CED MG SET VOLTAGE
REGULATOR

EVENT DATE: 05/17/96 LER #: 96-006-00 REPORT DATE: 06/17/96

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR
SECTION:

50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:

NAME: T. J. GAUDET, ACTING LICENSING TELEPHONE: (504) 739-6666
MANAGER

COMPONENT FAILURE DESCRIPTION:

CAUSE: X SYSTEM: PPS COMPONENT: RG MANUFACTURER: G080
REPORTABLE NPRDS: Y

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On May 17, 1996 at 2008 hours, with the plant in mode 1 at 100% power, a reactor trip occurred without any precursor alarms. The cause of the trip was the loss of both Control Element Drive (CED) Motor/Generator (M/G) Sets due to a failed voltage regulator based on heat related accelerated aging. The electrolytic capacitors on both M/G Set Overvoltage Relays were replaced and the retest was satisfactory. Also the 'A' M/G Set Voltage Regulator was replaced and the retest was successful. The plant responded as designed and the trip/actuation signals were generated when required. The plant was maintained throughout this event such that the health and safety of the general public was not compromised.

END OF ABSTRACT

Table "REQUIRED NUMBER OF DIGITS/CHARACTERS FOR EACH BLOCK" omitted.

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REPORTABLE OCCURRENCE

On May 17, 1996, at about 2008 hours, Waterford 3 was operating at approximately 100% Rated Thermal Power in Operational Mode 1 (Power Operations) when the plant tripped as a result of CED Motor/Generator (M/G) Set 'A' voltage regulator (EHS Identifier JC-RG) failing high. The voltage transient resulting from the failed voltage regulator caused CED MG Set 'B' load contactor and subsequently CED MG Set 'A' load contactor to open. The loss of Control Element Drive Mechanism Control System (CEDMCS) bus power resulted in the Reactor trip.

INITIAL CONDITIONS

At the time this event occurred, Waterford 3 was operating in MODE 1 at approximately 100 percent power. There was no major equipment out of service specific to this event and no Technical Specification Limiting Conditions for Operation (LCOs) in effect specific to this event at the time this event occurred. There were no precursor alarms.

EVENT DESCRIPTION

On May 17, 1996, at about 2006, Waterford 3 was operating at approximately 100% Rated Thermal Power in Operational Mode 1 (Power Operations) when the following sequence of events occurred (all times approximated):

20:06 The event was initiated by the degradation of the Voltage regulator of the 'A' CED Motor /Generator (M/G). This failure caused the 'A' M/G exciter field current to rise which resulted in the 'A' M/G voltage output rising. With the 'A' and 'B' M/G's operating in load share mode (i.e. both M/G's operating and in Sync. with the CEDMCS bus) the 'A' M/G load began rising and the 'B' M/G load began lowering. As the load on the 'B' M/G lowered the exciter current also lowered.

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20:07:09 The exciter field current of the 'B' M/G lowered to less than 1.6 amps (loss of field setpoint) causing the Ammeter Relay

(AMR) to open the load contactor of the 'B' M/G.

The output voltage of the 'A' M/G continued increasing and it is believed this caused a protective fuse in the 'A' M/G voltage regulator to blow. The blown fuse caused total loss of generator output voltage.

20:08:03 The exciter field current of the 'A' M/G lowered to less than 1.6 amps (loss of field setpoint) causing Ammeter Relay (AMR) to open the load contactor of the 'A' M/G. The total loss of output caused the coils for the Output Overvoltage and Output Under Frequency relays to de-energize which resulted in Local Control Panel Alarms Illuminating.

CEA's start gravity insertion and a Turbine trip signal is generated by the CEDMCS bus loss of voltage condition.

20:08:04 Core Protection Calculators sense dropping CEA's and the Reactor Protection Channels 'C' and 'D' Low DNBR and High LPD Reactor trips are actuated causing the Reactor Trip Switchgear Breakers to Open.

The Operating crew enters OP-902-000, Emergency Entry Procedure, and commences immediate operator actions.

20:08:09 The Main Generator trips due to the Turbine Trip.

20:08:15 Emergency Feedwater Actuation Signal-2 (EFAS 2) Actuated. Steam Generator #2 (S/G 2) level reached EFAS setpoint due to Reactor trip.

20:08:16 Emergency Feedwater Actuation Signal-1 (EFAS 1) Actuated. Steam Generator #1 (S/G 1) level reached EFAS setpoint due to Reactor trip.

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20:10 The Control Room staff receives a report of steam in the area of Steam Generator Feedwater Pumps (SGFP). Control Room staff manually trips SGFP Pump 'A' due to reported feedwater pump piping leak in progress.

The Control Room Operators note that two (2) Moisture Separator Reheater (MSR) isolation valves indicate intermediate position and dispatch an Auxiliary Operator (AO) to Close the MSR isolation valves.

20:11 AO reports to control room staff that CD-242B, SGFP 'B' suction relief is open and that Fire Protection Mains (FPM) for the SGFP are actuated and that no signs of fire exist.

20:12 Shift Supervisor (SS) at pump reports no fire exists. SS directs AO to isolate FPM 7 & 8.

20:15 AO reports to control room staff that CD-242A, SGFP 'A' suction relief is open. The valve subsequently closes, two minutes later.

20:18 Control Room staff enters OP-902-001, Uncomplicated Reactor Trip.

20:32 CD-242B, SGFP 'B' suction relief is closed but not fully seated. A steady flow of water into suction pipe pit continues.

20:35 "RPS Channel Trip S/G 2 Level Hi" annunciator activates due to High Steam Generator Level.

20:37 FW-184B, Main Feedwater Isolation Valve (MFIV) 2 Auto Closed due to High S/G Level >96%WR.

20:40 Control Room Closes FW-163B, Main Feedwater Regulating Valve Isolation.

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20:50 Control Room opens FW-184B, MFIV 2.

20:53 Control Room Closes FW-170B, Start-up Feedwater Regulating Valve Isolation.

20:55 Control Room staff Exits OP-902-001 and Enters OP-010-001, General Plant Operation, Section 8.6.

21:07 MFIV 2 Auto Closes for second time due to High S/G #2 Level

21:09 SGFP Pump 'A' turning gear engaging and disengaging automatically. Control Room dispatches AO to attempt to place SGFP 'A' on turning gear manually.

21:37 Control Room reopens MFIV 2.

21:43 Closed MS-215A, Main Steam to SGFP 'A' due to turning gear trouble.

22:02 MFIV 2 Auto Closes for third time due to High S/G #2 Level

22:25 Control Room reopens MFIV 2.

22:29 Opened MS-215A, Main Steam to SGFP 'A', in preparation for SGFP start. The SGFP 'A' was reset and the Low Pressure Stop valve was discovered to be sticking.

22:32 S/G #2 level continues to rise with the Start-up Feedwater Regulating Valve and the Main Feedwater Regulating Valve closed along with their respective isolation valves. It is suspected that FW-162B, Feedwater Regulating Valve Bypass, is leaking by its seat.

22:40 Control room staff closes MFIV 2 prior to Auto closure at 89% NR.

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23:10 MFIV 2 reopened for last time because SGFP speed will be used to control S/G 2 level.

23:11 SGFP B in local control to reduce speed in order to lower MFP discharge pressure and thereby lower feed rate to S/G 2, thus stabilizing S/G #2 level control.

23:27 Started SGFP A due to continued turning gear trouble.

23:29 Secured SGFP B, due to suction relief leaking by its seat.

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00:14 Established S/G #1 blowdown flow at 100 GPM.

00:30 Closed CD-230B, SGFP Pump B Suction Valve, due to suction relief leaking by its seat.

03:35 Entered Containment for valve BD-102B Inspection.

04:26 Established S/G #2 blowdown flow at 100 GPM.

09:00 Discovered FW-162B, Feedwater Regulating Valve Bypass partially open. Manually Closed FW-162B, Feedwater Regulating Valve

Bypass (approximately 1/2 inch stem travel).

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CAUSAL FACTORS

The root causes for this event are as follows:

o Equipment: Failed Component

The event was initiated by the degradation of the voltage regulator (model 3300A03B0073) for the 'A' Control Element Drive (CED) Motor /Generator (M/G), General Electric model 6PA4449A45. The cause of the failure was heat related accelerated aging due to high operating temperatures in the local control panel. This failure eventually lead to the loss of both CED M/Gs.

o Equipment: Original Design Inadequacies

Lack of coordination between the two redundant CED M/Gs allowed a single component failure to cause the loss of both CED M/Gs. Current system design does not provide for continued system function during high voltage regulator failures.

IMMEDIATE CORRECTIVE MEASURES

A megger test was satisfactorily performed on both the 'A' and 'B' M/G Sets. A test was also performed to verify the operation of the Overvoltage Relays for both M/G Sets. The results were unsatisfactory due to failed electrolytic capacitors. Subsequently, the electrolytic capacitors on both M/G Set Overvoltage Relays were replaced and the retest was satisfactory. (CI 303049)

In addition, a test was performed to verify operation of 'B' M/G Set Ammeter Relay. This test was completed with satisfactory results. (CI 303050)

The 'A' M/G Set Voltage Regulator was replaced and the retest was performed satisfactory.

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ACTIONS TO PREVENT RECURRENCE

The following actions are planned to prevent recurrence.

A. Replace M/G Set Voltage Regulators with enhanced model designed for high operating temperature in local control panel.

B. Initiate Station Modification Request to improve annunciation system for M/G Sets and improve system reliability for high voltage condition. This should also address reducing the operating temperature in the M/G Set local control panel. In conjunction with this, a review of other similarly configured redundant power supplies will be conducted by Design Engineering.

C. The Overvoltage Relays (OVR) on both M/G Sets were found to have failed capacitors. Initiate Preventive Maintenance action to address M/G Set OVR capacitor replacement.

D. Perform an assessment to determine the adequacy of the current Waterford 3 programs that identify and trend heat related failures of non-safety electronics.

SAFETY SIGNIFICANCE

Safety and Engineering Analysis reviewed the safety implications for this event. The cause of the trip was the loss of both Motor Generator Sets due to a failed voltage regulator. This resulted in loss of power to the CEA holding coils and the subsequent dropping of the control rods. This caused a reactor trip followed by a turbine and main generator trips. The Reactor Protection System (RPS) performed as designed and generated low DNBR and high LPD trips. These trips were caused by the control rods dropping. EFAS initiated on low steam generator level to maintain the S/Gs as heat

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sinks. Steam Bypass Control System (SBCS) valves quick opened to limit steam generator pressurization and remove Reactor Coolant System decay heat.

In conclusion, the plant responded as designed and the appropriate trip/actuation signals were generated when required. The plant was maintained throughout this event such that the health and safety of the general public was not compromised.

SIMILAR EVENTS

There have been no similar events reported as LERs at Waterford 3.

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D. R. Keuter
General Manager
Plant Operations
Waterford 3

W3F1-96-0090
A4.05
PR

June 17, 1996

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Subject: Waterford 3 SES
Docket No. 50-382
License No. NPF-38
Reporting of Licensee Event Report

Gentlemen:

Attached is Licensee Event Report Number LER-96-006-00 for Waterford Steam Electric Station Unit 3. This Licensee Event Report is submitted in accordance with 10CFR50.73(a)(2)(iv).

Very truly yours,

D.R. Keuter
General Manager
Plant Operations

DRK/OPP/ssf
Attachment

cc: L. J. Callan, NRC Region IV
C. P. Patel, NRC-NRR
D. F. Packer
J. T. Wheelock - INPO Records Center
R. B. McGehee

N. S. Reynolds
NRC Resident Inspectors Office
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*** END OF DOCUMENT ***
